US009056718B2

(12) **United States Patent**
Ito

(10) **Patent No.: US 9,056,718 B2**
(45) **Date of Patent: Jun. 16, 2015**

(54) **TRANSFER DEVICE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 233 days.

(21) Appl. No.: **13/696,808**

(22) PCT Filed: **May 13, 2010**

(86) PCT No.: **PCT/JP2010/003237**
§ 371 (c)(1),
(2), (4) Date: **Nov. 8, 2012**

(87) PCT Pub. No.: **WO2011/141966**
PCT Pub. Date: **Nov. 17, 2011**

(65) **Prior Publication Data**

US 2013/0058742 A1 Mar. 7, 2013

(51) **Int. Cl.**
B65G 1/133 (2006.01)
B65G 1/04 (2006.01)
H01L 21/677 (2006.01)

(52) **U.S. Cl.**
CPC ***B65G 1/0407*** (2013.01); *B65G 2201/0297* (2013.01); ***H01L 21/67766*** (2013.01); ***H01L 21/67769*** (2013.01)

(58) **Field of Classification Search**
CPC G07F 11/165; B65G 1/0407; B65G 2201/0297; H01L 21/67766; H01L 21/67769
USPC 414/281, 282, 749.1, 749.6
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,846,620	A *	7/1989	Mims	414/273
4,964,776	A	10/1990	Wakita et al.	
5,064,337	A	11/1991	Asakawa et al.	
5,468,110	A *	11/1995	McDonald et al.	414/273
5,791,512	A *	8/1998	Kanatsuka	221/2
6,079,927	A *	6/2000	Muka	414/217
6,506,009	B1	1/2003	Nulman et al.	
6,755,322	B1 *	6/2004	Herzog et al.	221/123

(Continued)

FOREIGN PATENT DOCUMENTS

JP	61-92610 U	6/1986
JP	01-145906 A	6/1989

(Continued)

OTHER PUBLICATIONS

Official Communication issued in International Patent Application No. PCT/JP2010/003237, mailed on Aug. 3, 2010.

(Continued)

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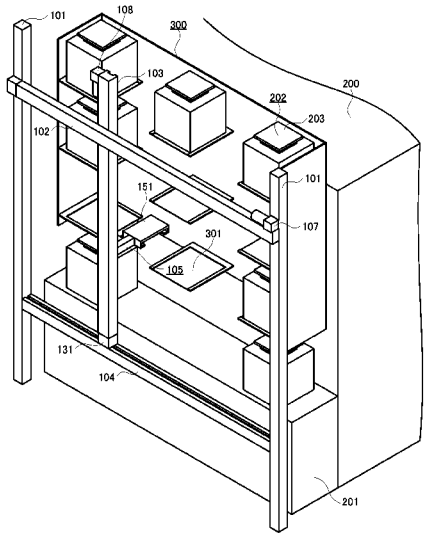
(57) **ABSTRACT**

A transfer device transfers an object stored on one of a plurality of shelf plates of a shelf. The transfer device includes two pillars vertically standing in front of the shelf, an upper rail attached to upper front surfaces of the two pillars so as to tie the two pillars together, a vertical rail provided in a plane including the two pillars and slidably connected to a side surface of the upper rail, a lower rail provided under the vertical rail, attached to lower portions of the two pillars, and connected to the vertical rail in a manner which allows the vertical rail to slide, and a holding unit slidably connected to a side surface of the vertical rail and arranged to detachably hold the object.

9 Claims, 4 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2004/0081546	A1	4/2004	Elliott et al.	
2005/0036856	A1	2/2005	Yamashita	
2007/0108222	A1*	5/2007	Collins et al.	221/251
2009/0065460	A1	3/2009	Murata et al.	
2011/0184751	A1*	7/2011	Holmes	705/2

FOREIGN PATENT DOCUMENTS

JP	01-203106	A	8/1989
JP	05-338732	A	12/1993
JP	10-172213	A	6/1998
JP	2001-298069	A	10/2001
KR	10-2009-0026099	A	3/2009

OTHER PUBLICATIONS

English translation of Official Communication issued in corresponding International Application PCT/JP2010/003237, mailed on Dec. 13, 2012.

Official Communication issued in corresponding European Patent Application No. 10851352.4, mailed on Aug. 27, 2014.

* cited by examiner

FIG. 1

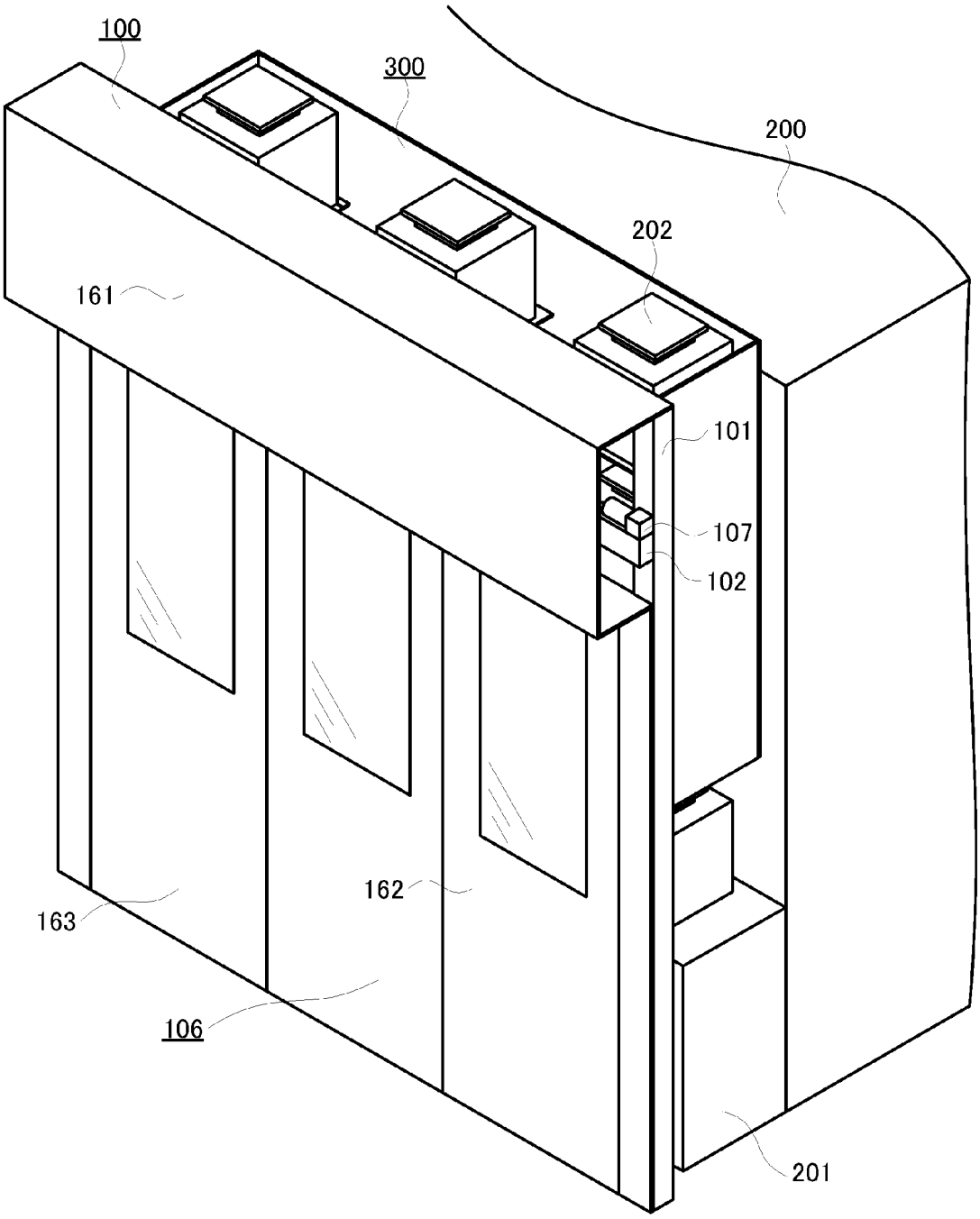


FIG. 2

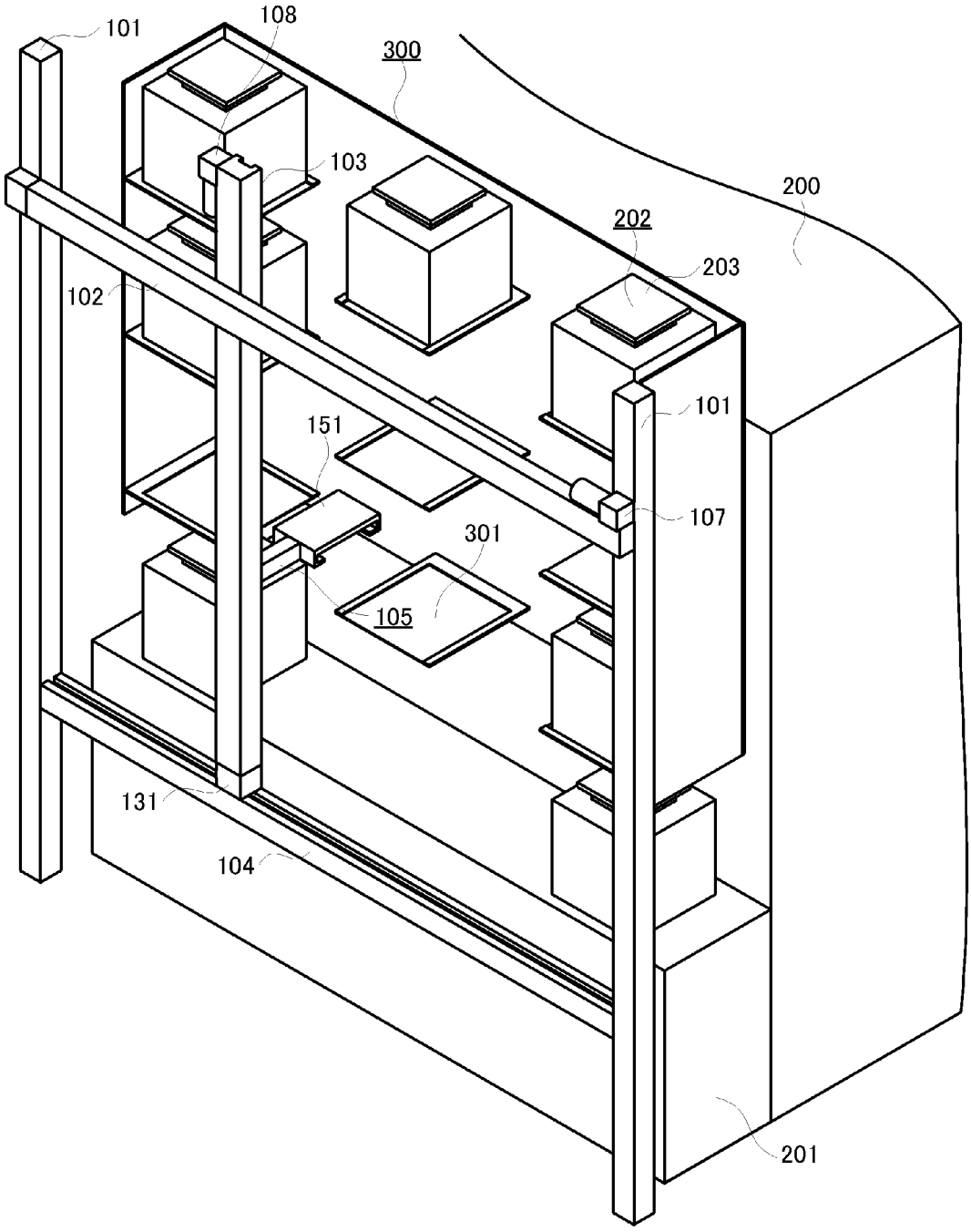


FIG. 3

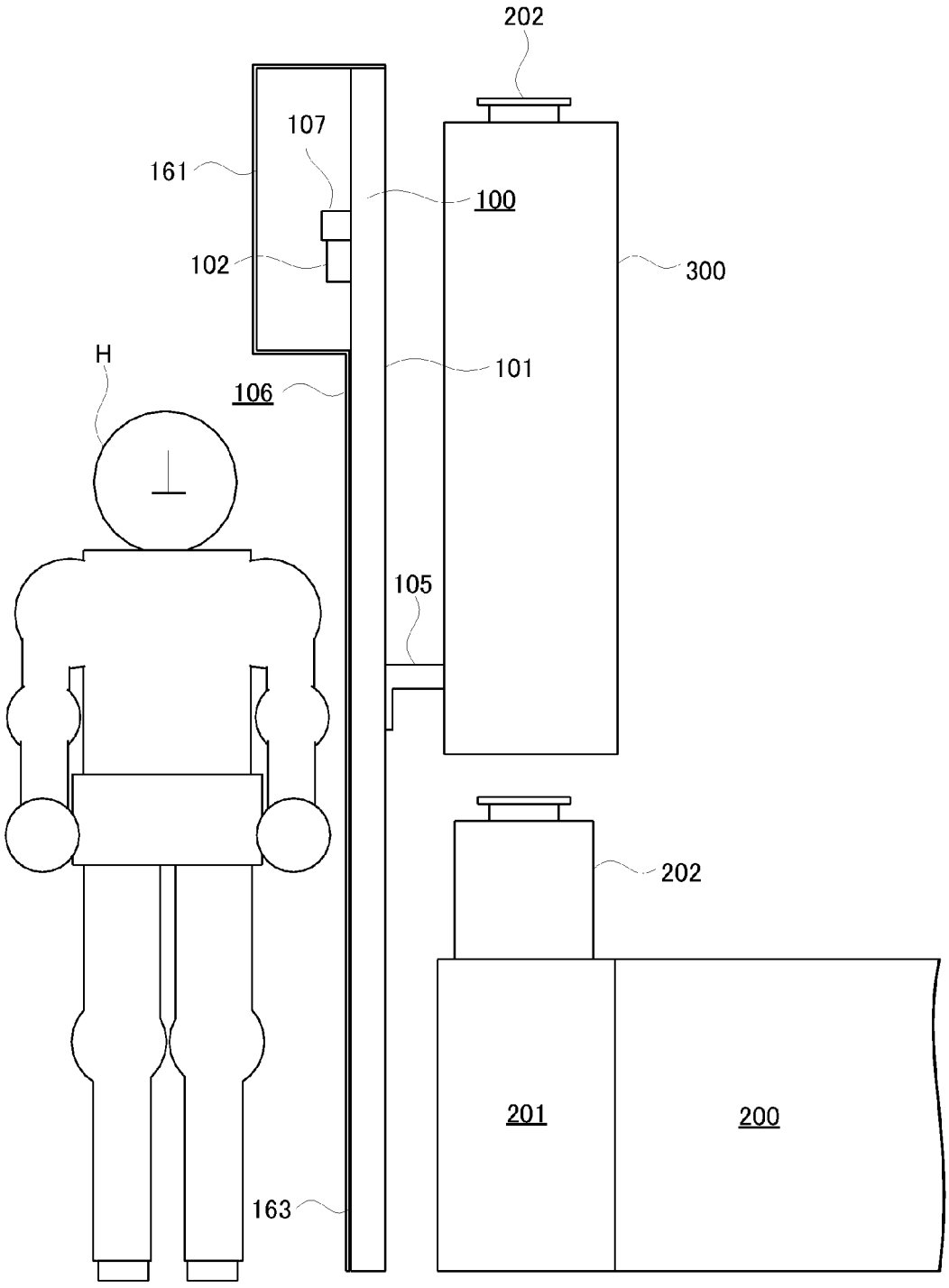
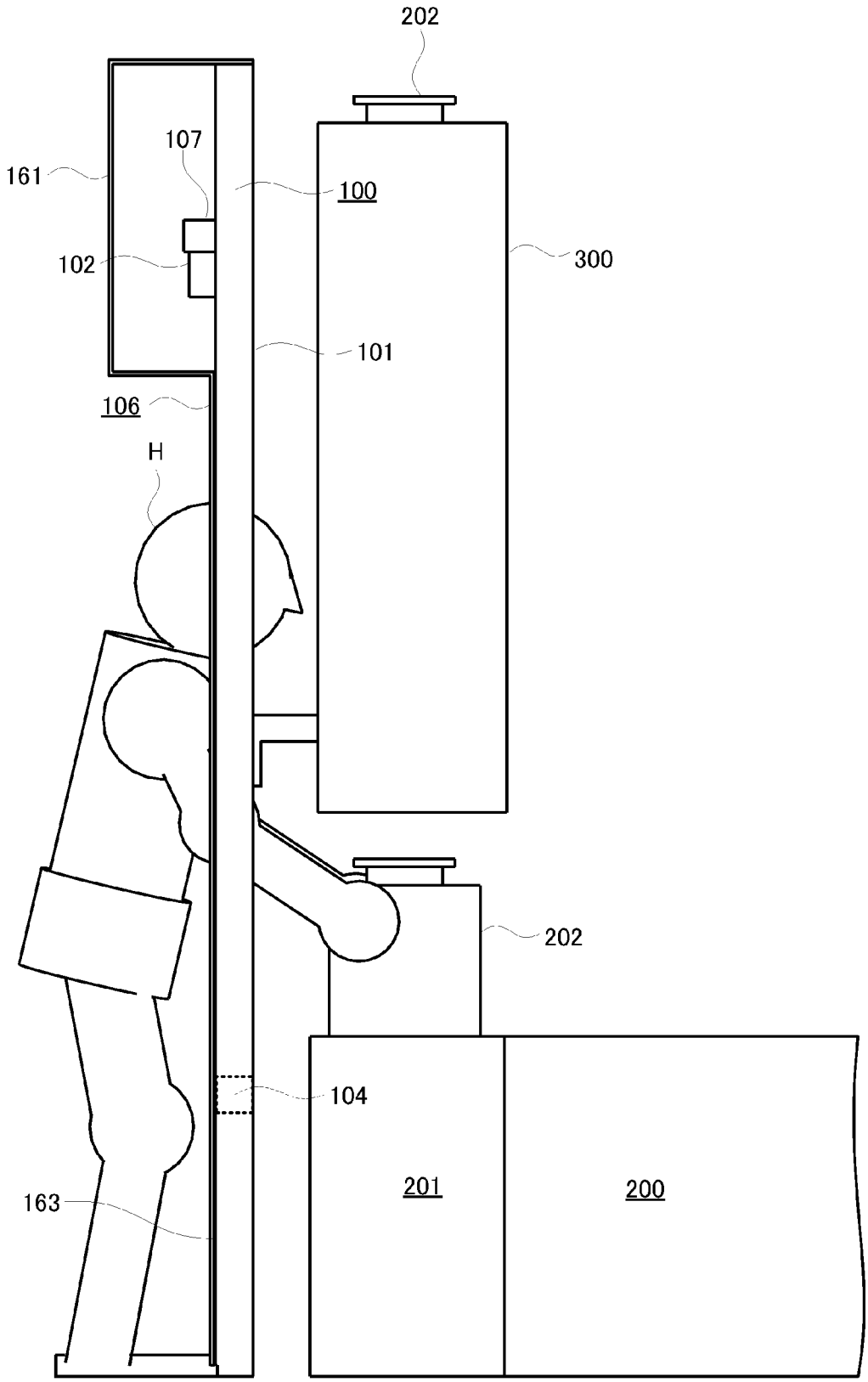


FIG. 4



TRANSFER DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a transfer device that is preferably provided between a semiconductor manufacturing device and an aisle, and used for a shelf that temporarily stores an object containing a substrate necessary to manufacture a semiconductor and changes a storage area for the object within the shelf.

2. Description of the Related Art

When substrates such as a glass substrate and a silicon substrate are brought from one location to a semiconductor manufacturing device and when processed substrates are carried to another location, a conventional scheme utilizes a box, referred to as a container, to contain multiple substrates and transfers the container. In transferring the container, an overhead transferring vehicle which travels near the ceiling is used to save space in a semiconductor manufacturing factory.

The container has to be temporarily stored, depending on how a preceding process and a supplemental process progress in the manufacturing process of semiconductors. In order to store the container, a shelf for storing the container is provided above a loader and an unloader for the semiconductor manufacturing device. The semiconductor manufacturing device has a transfer device. The transfer device can automatically transfer an appropriate container from the shelf to the loader when the substrates are ready to be processed. The transfer device can also automatically transfer from the unloader to the shelf a container containing processed substrates.

In order to save space, a semiconductor manufacturing factory has semiconductor manufacturing devices on both sides of an aisle across from each other. The loader and the unloader are provided between the semiconductor manufacturing device and the aisle. The transfer device is provided between the loader/unloader and the aisle.

Japanese Unexamined Patent Application Publication No. 2001-298069 discloses a transfer device and a shelf. The shelf in Japanese Unexamined Patent Application Publication No. 2001-298069 has horizontal and vertical aisles so that a container held by the transfer device can move inside the shelf. This structure saves as much space as possible. Moreover, the transfer device has rails each used for moving a holding unit, which holds a container, in the vertical direction and the horizontal direction. The rails are attached to the shelf. This structure provides aisles that are as wide as possible.

As recent substrates are becoming larger, a container for containing the substrates is becoming heavier. Such a trend requires a transfer device to be stiffer.

SUMMARY OF THE INVENTION

Accordingly, preferred embodiments of the present invention provide a transfer device which has sufficient stiffness and maintains a sufficiently wide aisle around the footprint of the transfer device.

A transfer device according to a preferred embodiment of the present invention transfers an object stored on one of a plurality of shelf plates to another one of the shelf plates, the shelf plates being arranged vertically and horizontally and provided to a shelf. The transfer device includes two pillars arranged to vertically stand in front of the shelf; an upper rail which is horizontally attached to upper front surfaces of the two pillars so as to tie the two pillars together; a vertical rail which is vertically and slidably connected to a side surface of the upper rail; a lower rail which is provided under the vertical rail sandwiched between the two pillars to tie the two pillars together such that both ends of the lower rail abut lower portions of the two pillars, and connected to the vertical rail in a manner which allows the vertical rail to slide, the vertical rail being provided in a plane formed in phantom between the two pillars; and a holding unit which projects from the vertical rail to the shelf and is slidably connected to a side surface of the vertical rail, and configured to detachably hold the object, wherein the vertical rail moves in the plane.

This structure allows the upper rail and the lower rail to guide the vertical rail, which contributes to improving stiffness of the transfer device. This structure also makes it possible to disperse a load between the upper rail and the lower rail. Consequently, the upper rail can be made thinner to avoid excessively projecting into the aisle. Furthermore, the lower rail is preferably provided in the same plane as the pillars are. This structure makes it possible to substantially reduce an above-the-ground thickness of the transfer device, which a user can feel when passing by. Consequently, this feature contributes to providing a wider aisle.

Furthermore, the transfer device may preferably include a cover which is provided in front of the two pillars, and covers a moving area of the holding unit, wherein the cover includes an upper cover which covers the upper rail, and a lower cover which is provided behind the upper cover and covers a lower portion of the moving area.

The upper rail may preferably include a horizontal driving unit configured to horizontally drive the vertical rail, and the lower rail may not include the horizontal driving unit.

This structure makes it possible to use a thin lower rail for the transfer device, which contributes to providing a wider aisle.

The vertical rail may include a vertical driving unit which is attached to a side surface at an upper end of the vertical rail, and vertically drives the holding unit, and the upper rail may be provided below the vertical driving unit.

This structure makes it possible to keep a space wide over the transfer device, which contributes to easily preventing interference of the transfer device with the object held by the overhead traveling vehicle.

The above and other elements, features, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of the preferred embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** depicts a perspective view showing a transfer device as a whole.

FIG. **2** depicts a perspective view showing the transfer device with a cover removed.

FIG. **3** depicts a plan view showing the transfer device and a user from the side.

FIG. **4** is a plan view showing from the side how the user opens a door and reaches an object.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will described with reference to the drawings.

FIG. **1** depicts a perspective view showing a transfer device as a whole.

FIG. **2** depicts a perspective view showing the transfer device without a cover.

As shown in the drawings, a transfer device **100** is provided in front of a device **200**, such as a semiconductor manufacturing device, and a loader and unloader **201**, and transfers an object **202** from one of a plurality of shelf plates **301** to another one of the shelf plates **301**. Here, the shelf plates **301** preferably are vertically and horizontally arranged, and provided to a shelf **300**. The transfer device **100** includes pillars **101**, an upper rail **102**, a vertical rail **103**, a lower rail **104**, a holding unit **105**, a cover **106**, a horizontal driving unit **107**, and a vertical driving unit **108**.

The pillars **101** vertically stand in front of the shelf **300**. In the present preferred embodiment, the pillars **101** are arranged such that a space therebetween is slightly wider than the width of the device **200**, and arranged so that a plane located between the two pillars is parallel or substantially parallel with the front surface of the device **200**.

The upper rail **102** is horizontally attached to the upper front surfaces of the two pillars **101** in order to tie the pillars **101** together. In the present preferred embodiment, the upper rail **102** includes an endless belt used to horizontally drive the vertical rail **103**.

The vertical rail **103** is vertically provided in the plane including the two pillars **101**, and is slidably attached to a side surface of the upper rail **102**. The vertical rail **103** and the upper rail **102** are arranged so that they overlap with each other in a front-back direction.

The lower rail **104** is provided in a plane formed in phantom between the two pillars **101**. The lower rail **104** is provided under the vertical rail **103**, and sandwiched between the two pillars **101** to tie the pillars **101** together such that both ends of the lower rail **104** abut lower portions of the two pillars **101**. Moreover, the lower rail **104** is attached to the vertical rail **103** in a manner which allows the vertical rail **103** to slide. In other words, the lower rail **104** and the vertical rail **103** are provided in the same plane, and the vertical rail **103** moves in the plane.

In the present preferred embodiment, the lower rail **104** and the vertical rail **103** are connected to each other via a pulley case **131**. The pulley case **131** is fixed to the vertical rail **103**. Thus, the pulley case **131** and the vertical rail **103** move together in a direction where the lower rail **104** extends. It is noted that in the case where the pulley case **131** has insufficient stiffness, a bracket may be provided to connect the vertical rail **103** with the lower rail **104**, bypassing the pulley case **131**.

The holding unit **105** detachably holds the object **202**. The holding unit **105** projects from the vertical rail **103** to the shelf **300**, and is slidably connected to a side surface of the vertical rail **103**.

In the present preferred embodiment, a flange **203** is provided on an upper portion of the object **202** to hold the object **202**. The holding unit **105** horizontally moves to hold and release the flange **203**. The holding unit **105** includes a hook **151**. When the flange is inserted into the hook **151**, the hook catches the bottom surface of the flange **203** and lifts the object **202**.

The horizontal driving unit **107** is attached to an end of the upper rail **102**, and horizontally drives the vertical rail **103**. In the present preferred embodiment, the horizontal driving unit **107** drives the endless belt, included in the upper rail **102**, in a forward direction and a backward direction. Hence, the vertical rail **103** attached to the endless belt horizontally moves, being guided by the upper rail **102** and the lower rail **104**.

It is noted that the horizontal driving unit **107** preferably is not attached to the lower rail **104**. This is because the lower space in front of the transfer device **100** is preferably kept wide. Hence, as long as the lower space is not affected, a small driving unit may be attached to the lower rail **104**.

The vertical driving unit **108** is attached to a side surface at the upper end of the vertical rail **103**, and vertically drives the holding unit **105**. In the present preferred embodiment, similar to the upper rail **102**, the vertical driving unit **108** drives an endless belt, attached to the vertical rail **103**, in a forward direction and a backward direction. Hence, the holding unit **105** attached to the endless belt is guided by the vertical rail **103**, and vertically moves.

In the present preferred embodiment, the upper rail **102** is preferably provided below the vertical driving unit **108**. Thus, when the vertical driving unit **108** moves together with the vertical rail **103**, the vertical driving unit **108** and the upper rail **102** do not interfere with each other.

The cover **106** is a wall-shaped member which separates the user and the transfer device **100** when the transfer device **100** is running. The cover **106** is provided in front of the two pillars **101** to cover the entire moving area of the holding unit **105**. The cover **106** preferably includes an upper cover **161** which (i) projects forward to cover the upper rail **102** located in the upper moving area and (ii) extends along the upper rail **102**; and a lower cover **163** which (i) is provided behind the upper cover **161** and (ii) covers the lower portion of the lower part of the moving area. In the present preferred embodiment, the lower cover **163** preferably includes three doors **162**. The user opens the doors **162** to reach the transfer device **100** and the loader and unloader **201**.

The shelf **300** is provided above the loader and unloader **201**, and temporarily stores an object **202** received from an overhead transferring vehicle and another object **202** to be transferred to an overhead transferring vehicle. In other words, the shelf **300** acts as a buffer for the objects **202** provided near a machine. In the present preferred embodiment, the shelf **300** preferably includes three columns of the shelf plates **301**, and each column preferably includes three shelf plates **301** vertically arranged. Thus, the shelf **300** can store nine objects **202** in total. Furthermore, the shelf **300** includes an aisle vertically extending between the shelf plates **301**. This structure allows the object **202** to be vertically moved in the shelf **300**.

Furthermore, a space is provided between the shelf **300** and the loader and unloader **201**, so that the object **202** can be horizontally moved through the space. Thus, the shelf **300** allows the transfer device **100** to freely transfer the object **202** inside the shelf **300**.

The loader and unloader **201** is a device which brings to the device **200** a substrate contained in the object **202**, and puts a processed substrate into the object **202** and carries the object **202**. In the present preferred embodiment, the loader and unloader **201** also works as the shelf **300** to temporarily store the object **202**.

FIG. **3** depicts a plan view showing the transfer device and the user from the side.

The transfer device **100** described above includes the upper rail **102** and the lower rail **104** horizontally provided. In addition to the high stiffness, the transfer device **100** includes forward-projecting (on the left of FIG. **3**) portions concentrated in its upper area. Such a structure allows the transfer device **100** to maintain a desired width for a user H and a vehicle to travel. In other words, the transfer device **100** can keep the aisle width substantially wide.

Furthermore, the vertical driving unit **108** preferably is not provided above the pillars **101**, and does not interfere with the upper rail **102**. This structure can keep a space wide over the entire or substantially the entire transfer device **100**. Hence, even though an overhead traveling vehicle is provided over

the device **200**, this structure successfully prevents interference of the transfer device **100** with the overhead traveling vehicle.

FIG. **4** is a plan view showing from the side how the user opens a door and reaches an object.

As shown in FIG. **4**, suppose the case where the transfer device **100** is out of service, and the user H opens the doors **162** on the cover **106** to reach an object **202** stored on the loader and unloader **201**. Even in such a case, the user H is not bothered by the lower rail **104**, and can easily reach the object **202**. This is because the lower rail **104** is provided to a relatively lower portion of the transfer device **100**, and does not project forward of the pillars **101**.

It is noted that the present invention is not limited to the above preferred embodiment. For example, instead of catching the flange **203** provided on an upper portion of the object **202** and transferring the object **202** with the object suspended, the holding unit **105** may include a hook to be inserted into a lower portion of the object **202** and to lift the object **202**. The shelf **300** can store the objects **202** three high and three wide, for example. The loader and unloader **201** according to the above-described preferred embodiment also stores the objects **202**. Consequently, the loader and unloader **201** is a part of the shelf **300**.

Any given combination of the constitutional features described in the specification may be appreciated to implement a preferred embodiment of the present invention other than the above described preferred embodiment. Although exemplary preferred embodiments of the present invention have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible to the exemplary preferred embodiments without materially departing from the novel aspects of the present invention. Accordingly, all such modifications are intended to be included within the scope of the present invention.

The words such as "vertical", "plane", and "parallel" are used within a margin of error without departing from the intents of the present invention. Moreover, the word "loader and unloader" describes a device which is capable of either (i) one of bringing in and carrying out an object, or (ii) both bringing in and carrying out of an object.

Preferred embodiments of the present invention are applicable to an automated shelf for a machine placed near a semiconductor manufacturing device, for example.

While preferred embodiments of the present invention have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing from the scope and spirit of the present invention. The scope of the present invention, therefore, is to be determined solely by the following claims.

The invention claimed is:

1. A transfer device which transfers an object stored on one of a plurality of shelf plates to another one of the plurality of shelf plates, the plurality of shelf plates being arranged vertically and horizontally on a shelf, the transfer device comprising:

at least two pillars arranged to vertically stand in front of the shelf;

an upper rail which is horizontally attached to upper front exterior surfaces of the at least two pillars so as to tie the at least two pillars together;

a vertical rail which is vertically and slidably connected to a side surface of the upper rail;

a lower rail which is provided under the vertical rail, sandwiched between the at least two pillars to tie the at least two pillars together such that both ends of the lower rail abut lower portions of the at least two pillars, and connected to the vertical rail so as to allow the vertical rail to slide; and

a holding unit which projects from the vertical rail to the shelf and is slidably connected to a side surface of the vertical rail, and configured to detachably hold the object; wherein

the vertical rail, the lower rail, and the at least two pillars are arranged in a same plane formed in phantom between the at least two pillars;

the upper rail is located outside of the plane and arranged in parallel with the plane; and

the vertical rail is arranged to move in the plane.

2. The transfer device according to claim **1**, further comprising a cover which is provided in front of the at least two pillars and covers a moving area of the holding unit, wherein the cover includes an upper cover which covers the upper rail, and a lower cover which is provided behind the upper cover and covers a lower portion of the moving area.

3. The transfer device according to claim **1**, wherein the upper rail includes a horizontal driving unit which is attached to an end of the upper rail and configured to horizontally drive the vertical rail, and the lower rail does not include the horizontal driving unit.

4. The transfer device according to claim **1**, wherein the vertical rail includes a vertical driving unit which is attached to a side surface at an upper end of the vertical rail and configured to vertically drive the holding unit, and the upper rail is provided below the vertical driving unit.

5. The transfer device according to claim **1**, wherein the vertical rail is connected to a rear surface of the upper rail.

6. The transfer device according to claim **1**, wherein the vertical rail is arranged between the upper rail and the shelf.

7. The transfer device according to claim **1**, wherein the vertical rail is arranged between the upper rail and the shelf.

8. The transfer device according to claim **2**, wherein the transfer device is arranged between the shelf and the cover.

9. The transfer device according to claim **2**, wherein the lower cover includes at least one door that is openable by a user to provide access to the transfer device.

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